CLAIMS

We claim:

1. A method for removing a portion of the binder phase from a surface of a substrate comprising particles of at least a first phase joined together by the binder phase, the method comprising the act of etching said surface of said substrate by contacting said surface with a gas flow comprising an etchant gas and a second gas for a period of time that will remove said portion of said binder phase, said second gas comprising one or more gases that will not react with said substrate or said portion and that will not change the oxidation state of said substrate during said etching step.

2. The method recited in claim 1 wherein said second gas will not react with said substrate during said etching act to form an eta phase on said surface.

3. The method recited in claim 2 wherein said second gas is one or more selected from nitrogen gas, helium gas, argon gas, and neon gas.

4. The method recited in claim 3 wherein said etchant gas is one or more selected from hydrogen chloride gas, H_2F_2 gas, and gaseous forms of any of the Group VIIA elements.

5. The method recited in claim 4 wherein said gas flow comprises concurrent flows of hydrogen chloride gas and nitrogen gas.

6. The method of claim 1 wherein in said etching step said binder phase is removed from said surface to a depth of between about 3 microns to about 15 microns.

7. The method of claim 6 wherein in said etching step said binder phase is removed from said surface to a depth of between about 4 microns to about 6 microns.

8. The method of claim 1 wherein said substrate is of a composite material, said composite material comprising particles of a hard constituent material and a binder material, said binder material joining together said particles of said hard constituent material.

9. The method of claim 8 wherein said composite material is selected from cemented carbides and cermets.

10. The method of claim 8 wherein said hard constituent material comprises one or more material selected from the group consisting of:

a carbide material selected from the group consisting of tungsten carbide, titanium carbide, tantalum carbide, niobium carbide, vanadium carbide, chromium carbide, molybdenum carbide, and iron carbide;

a carbonitride of a refractory metal;

a nitride of a refractory metal;

a carbonitride of an element selected from the group consisting of W, Ti, Ta, Nb, V, Cr, Mo, and Fe;

an oxide of an element selected from the group consisting of aluminum, zirconium, and magnesium;

a boride of an element selected from the group consisting of aluminum, zirconium, and magnesium; and

a material selected from the group consisting of tungsten, a molybdenum-containing material, and a tungsten-containing material.

11. The method of claim 8 wherein said binder material comprises one or more materials selected from the group consisting of cobalt, nickel, iron, elements within Group VIII of the periodic table, copper, tungsten, zinc, and rhenium.

12. The method of claim 8 wherein said hard constituent material comprises tungsten carbide and wherein said binder phase comprises cobalt.

13. The method of claim 12 wherein said gas flow comprises hydrogen chloride gas and nitrogen gas.

14. The method of claim 1 wherein said etching act occurs within a chamber into which said gas flow is introduced.

15. The method of claim 1 further comprising the act of depositing a coating on said surface of said substrate after said etching act, and wherein at least a portion of said coating infiltrates voids in said surface produced by removal of said binder material from said surface of said substrate.

16. The method of claim 15 wherein said coating enhances the wear resistance of said substrate.

17. The method of claim 16 wherein said coating is comprised of one or more materials selected from the group consisting of TiC, TiN, TiCN, diamond, Al_2O_3, TiAlN, HfN, HfCN, HfC, ZrN, ZrC, ZrCN, BC, Ti_2B, MoS, Cr_3C_2, CrN, CrCN, and CN.

18. The method of claim 16 wherein said coating is an MT-milling coating.

19. The method of claim 1 wherein said substrate is selected from the group consisting of metal cutting inserts, dies, punches, stamps, threading devices, blanking devices, milling devices, turning devices, drilling devices, boring devices, mining bits, drilling bits, tricone bits, percussive bits, road planing devices, wood working bits, wood working blades, drawing devices, heading

devices, back extrusion devices, rod mill roll devices, and wear parts used in corrosive environments.

20. A method for applying a coating at least a portion of the surface of a substrate, the substrate comprising particles of a hard constituent material in a binder phase, the method comprising the acts of :

removing a portion of said binder phase from said surface of said substrate by contacting said surface with a gas flow comprising an etchant gas and a second gas for a period of time that will remove said portion of said binder phase to thereby provide an etched surface on said substrate, said etched surface comprising voids produced by removal of said portion of said binder phase, said second gas comprising one or more gases that will not react with said substrate or said portion and that will not change the oxidation state of said substrate during said etching step; and

applying said coating to at least a portion of said etched surface, at least a portion of said coating being deposited within at least a portion of said voids in said etched surface.

21. The method recited in claim 20 wherein said second gas will not react with said substrate or said binder phase removed from said surface during said removing act to form an eta phase within said voids on said etched surface.

22. The method recited in claim 20 wherein said second gas is one or more selected from nitrogen gas, helium gas, argon gas, and neon gas.

23. The method recited in claim 20 wherein said etchant gas is one or more selected from hydrogen chloride gas, H_2F_2 gas, and gaseous forms of any of the Group VIIA elements.

24. The method recited in claim 23 wherein said gas flow comprises concurrent flows of hydrogen chloride gas and nitrogen gas.

25. The method of claim 20 wherein in said etching step said binder phase is removed from said surface to a depth of between about 3 microns to about 15 microns.

26. The method of claim 25 wherein in said etching step said binder phase is removed from said surface to a depth of between about 4 microns to about 6 microns.

27. The method of claim 20 wherein said substrate is of a composite material, said composite material comprising particles of a hard constituent material and a binder material, said binder material joining together said particles of said hard constituent material.

28. The method of claim 27 wherein said composite material is selected from cemented carbides and cermets.

29. The method of claim 27 wherein said hard constituent comprises one or more material selected from the group consisting of:

a carbide material selected from the group consisting of tungsten carbide, titanium carbide, tantalum carbide, niobium carbide, vanadium carbide, chromium carbide, molybdenum carbide, and iron carbide;

a carbonitride of a refractory metal;

a nitride of a refractory metal;

a carbonitride of an element selected from the group consisting of W, Ti, Ta, Nb, V, Cr, Mo, and Fe;

an oxide of an element selected from the group consisting of aluminum, zirconium, and magnesium;

a boride of an element selected from the group consisting of aluminum, zirconium, and magnesium; and

a material selected from the group consisting of tungsten, a molybdenum-containing material, and a tungsten-containing material.

30. A coated substrate produced by the method of claim 20 wherein said hard constituent material of said substrate comprises WC, said binder phase comprises cobalt, and said gas flow comprises concurrent flows of hydrogen chloride gas and nitrogen gas.

31. The method of claim 27 wherein said binder material comprises one or more materials selected from the group consisting of cobalt, nickel, iron, elements within Group VIII of the periodic table, copper, tungsten, zinc, and rhenium.

32. The method of claim 27 wherein said hard constituent material comprises tungsten carbide and wherein said binder phase comprises cobalt.

33. The method of claim 20 wherein said act of removing occurs within a chamber into which said gas flow is introduced.

34. The method of claim 20 wherein said coating enhances the wear resistance of said substrate.

35. The method of claim 34 wherein said coating is comprised of one or more materials selected from the group consisting of TiC, TiN, TiCN, diamond, and Al_2O_3, TiAlN, HfN, HfCN, HfC, ZrN, ZrC, ZrCN, BC, Ti_2B, MoS, Cr_3C_2, CrN, CrCN, and CN.

36. The method of claim 34 wherein said coating is an MT-milling coating.

37. The method of claim 20 wherein:

said substrate is selected from the group consisting of metal cutting inserts, dies, punches, stamps, threading devices, blanking devices, milling

devices, turning devices, drilling devices, boring devices, mining bits, drilling bits, tricone bits, percussive bits, road planing devices, wood working bits, wood working blades, drawing devices, heading devices, back extrusion devices, rod mill roll devices, and wear parts used in corrosive environments; and

said coating enhances the wear resistance of said substrate.

38. The method of claim 37 wherein said coating is an MT-milling coating.

39. An object comprising:

a substrate comprised of a composite material, said composite material comprising particles of a hard constituent material and a binder material, said binder material joining together said particles of said hard constituent material, said substrate further comprising a surface portion having voids thereon provided by removing a portion of said binder material from said surface portion, said portion of said binder material being removed from said surface portion by contacting said surface portion with concurrent flows of at least a first gas and a second gas, said first gas capable of removing said binder material from said substrate, said second gas incapable of reacting with said substrate or changing the oxidation state of said substrate during removal of said portion of said binder material; and

a coating adhered to at least a portion of said surface portion of said substrate, at least a portion of said coating being deposited within at least a portion of said voids, said voids lacking eta phase deposits therein.

40. The object of claim 39 wherein said second gas is one or more selected from nitrogen gas, helium gas, argon gas, and neon gas, and wherein said first gas is one or more selected from hydrogen chloride gas, H_2F_2 gas, and gaseous forms of any of the Group VIIA elements.

41. The object of claim 39 wherein said voids have a depth of between about 3 microns to about 15 microns.

42. The object of claim 39 wherein said composite material is selected from cemented carbides and cermets.

43. The object of claim 39 wherein said hard constituent material comprises one or more material selected from the group consisting of:

a carbide material selected from the group consisting of tungsten carbide, titanium carbide, tantalum carbide, niobium carbide, vanadium carbide, chromium carbide, molybdenum carbide, and iron carbide;

a carbonitride of a refractory metal;

a nitride of a refractory metal;

a carbonitride of an element selected from the group consisting of W, Ti, Ta, Nb, V, Cr, Mo, and Fe;

an oxide of an element selected from the group consisting of aluminum, zirconium, and magnesium;

a boride of an element selected from the group consisting of aluminum, zirconium, and magnesium; and

a material selected from the group consisting of tungsten, a molybdenum-containing material, and a tungsten-containing material.

44. The object of claim 39 wherein said hard constituent material of said substrate comprises WC, said binder phase comprises cobalt, said first gas comprises hydrogen chloride gas, and said second gas comprises nitrogen gas.

45. The object of claim 39 wherein said binder material comprises one or more materials selected from the group consisting of cobalt, nickel, iron, elements within Group VIII of the periodic table, copper, tungsten, zinc, and rhenium.

46. The object of claim 39 wherein said coating enhances the wear resistance of said substrate and is comprised of one or more materials selected from the group consisting of TiC, TiN, TiCN, diamond, Al_2O_3, TiAlN, HfN, HfCN, HfC, ZrN, ZrC, ZrCN, BC, Ti_2B, MoS, Cr_3C_2, CrN, CrCN, and CN.

47. The object of claim 39 wherein said coating is an MT-milling coating.

48. The object of claim 39 wherein:

said object is selected from the group consisting of metal cutting inserts, dies, punches, stamps, threading devices, blanking devices, milling

devices, turning devices, drilling devices, boring devices, mining bits, drilling bits, tricone bits, percussive bits, road planing devices, wood working bits, wood working blades, drawing devices, heading devices, back extrusion devices, rod mill roll devices, and wear parts used in corrosive environments; and

said coating enhances the wear resistance of said substrate.